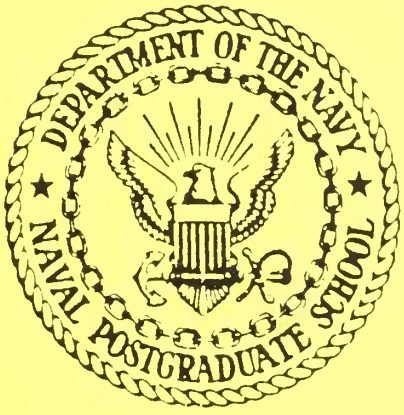
NPS68-85-006

NAVAL POSTGRADUATE SCHOOL

Monterey, California



HYDROGRAPHIC DATA FROM THE OPTOMA PROGRAM
OPTOMA8
10 and 15 December 1983

by

Paul A. Wittmann
Michele M. Rienecker
Edward A. Kelley, Jr.
Christopher N.K. Mooers

February 1985

Prepared for:
Office of Naval Research
Environmental Sciences Directorate (Code 420)
Arlington, VA 22217

NAVAL POSTGRADUATE SCHOOL

Monterey, California 93943

Commodore R.H. Shumaker
Superintendent

David A. Schrady
Provost

This report is for the research project "Ocean Prediction Through Observations, Modeling and Analysis" sponsored by the Physical Oceanography Program of the Office of Naval Research under Program Element 61153N.

This report was Prepared by:

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NPS-68-85-006
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): HYDROGRAPHIC DATA FROM THE OPTOMA PROGRAM OPTOMA8, 10 and 15 DECEMBER, 1983

5. TYPE OF REPORT & PERIOD COVERED: Report for October 1982 to January 1985

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Paul A. Wittmann, Michele M. Rienecker, Edward A. Kelley, Jr., Christopher N.K. Mooers

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Postgraduate School, Department of Oceanography, Monterey, CA 93943

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 61153N, N000148WR24051

11. CONTROLLING OFFICE NAME AND ADDRESS: Office of Naval Research (Code 420), Arlington, VA 22217

12. REPORT DATE: February 1985

13. NUMBER OF PAGES: (29)

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

California Current System
Physical Oceanography
Dynamic Oceanography

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The two flights comprising OPTOMA8 were undertaken on 10 and 15 December, 1983 to sample a subdomain of the California Current System. This report presents the hydrographic data, acquired by AXBT deployments, from the flight.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

Hydrographic Data from the **OPTOMA** *Program: OPTOMA8*

10 and 15 *December, 1983*

by

Paul A. Wittmann
Michele M. Rienecker
Edward A. Kelley, Jr
Christopher N. K. Mooers

The **OPTOMA** Program is a joint program of

Department of Oceanography
Naval Postgraduate School
Monterey, CA 93943.

Center for Earth and Planetary Physics
Harvard University
Cambridge, MA 02138.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

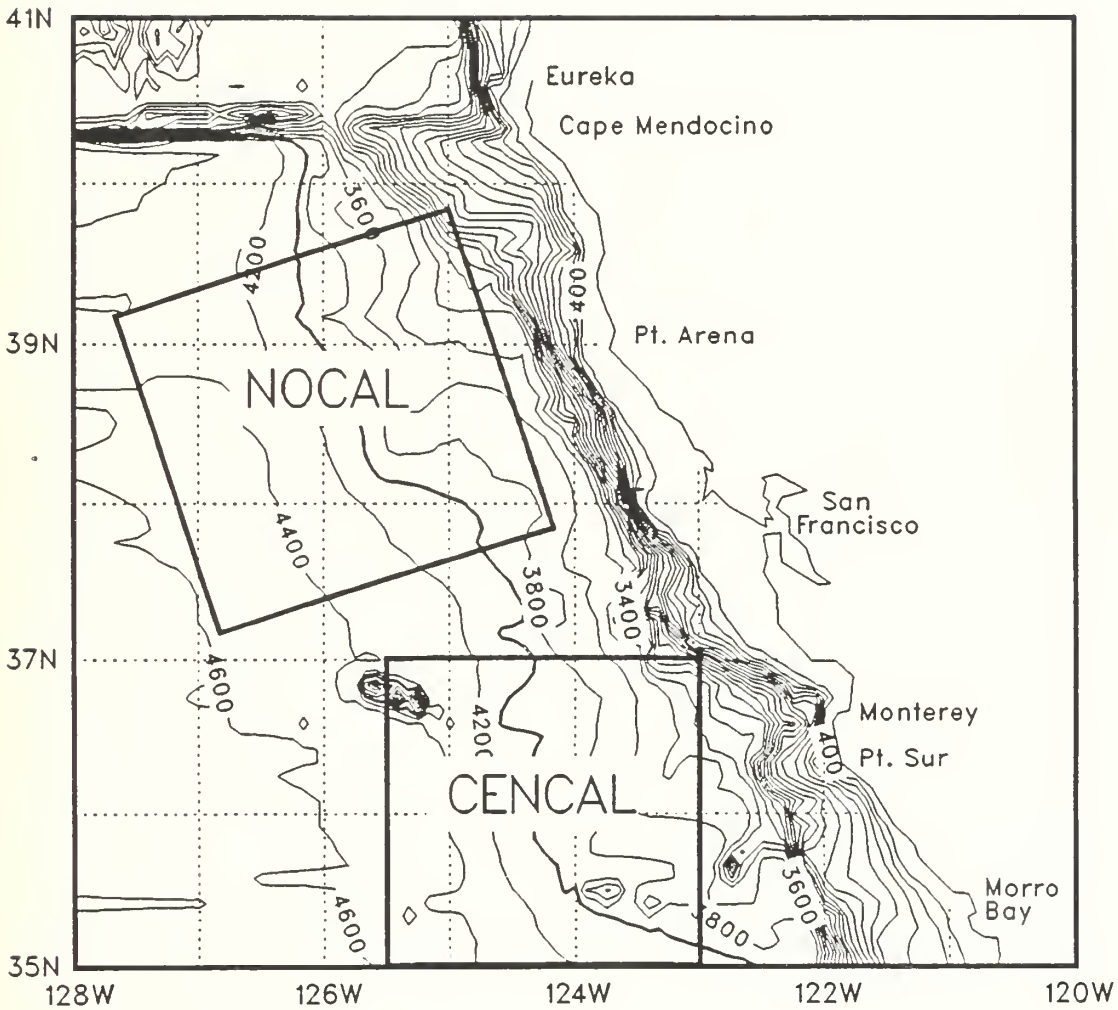


Figure 1: The NOCAL and CENCAL subdomains of the OPTOMA Program. Isobaths are shown in meters.

INTRODUCTION

The OPTOMA (Ocean Prediction Through Observations, Modeling and Analysis) Program, a joint NPS/Harvard program sponsored by ONR, seeks to understand the mesoscale (fronts, eddies, and jets) variability and dynamics of the California Current System and to determine the scientific limits to practical mesoscale ocean forecasting. To help carry out the aims of this project, a series of cruises has been planned in two subdomains, NOCAL and CENCAL, shown in Figure 1.

In December, 1983 two flights comprising OPTOMA8 were undertaken by a Navy Reserve Patrol Wing and together provided coverage of both the NOCAL and CENCAL domains. The flight on 10 December is denoted Leg I and covered the northern half of the domains; on 15 December, Leg II covered the southern half of the domains. Bathythermographic data were acquired along the tracks shown in figure 2. The total areal coverage was roughly 450 km alongshore by 360 km cross-shore. Nominal station spacing was about 40 km along-track.

DATA ACQUISITION

During Leg I a shallow (400m) or deep (800m) Sippican AXBT (Airborne Expendable Bathythermograph) was deployed on station from a Navy P3 aircraft; during Leg II only shallow AXBT's were deployed. The aircraft maintained an altitude of approximately 1500 ft and an airspeed of 210 knots. The data were recorded onboard on audio tapes using a 16-channel recorder. Analog traces were also produced using two lofargram recorders which operated on UHF channels 14 and 16.

Station positions were obtained from the aircraft's Inertial Navigation System with hourly updates by radar and TACAN (Tactical Air Navigation); accuracy of position is within 1 km. The thermistor on the Sippican AXBT has an accuracy of +0.18C in temperature and +2% or 5m (whichever is greater) in depth.

DATA PROCESSING

The data presented in this report are the result of hand digitization of the temperature profiles on the analog traces. Only inflection points were digitized, giving an average of about 15 points per shallow profile and about 20 points per deep profile. The digitization procedure was carried out by NAVOCEANO personnel who used an HP digitizing pad. The data, provided for OPTOMA on magnetic tape, were transferred to the IBM 3033 at the Naval Postgraduate School and edited by removing obvious cast failures that were not identified during the flight or digitization procedure. From the Leg I data set approximately 97% of casts were retained; of these 37 were from deep and 23 from shallow AXBT's. From the Leg II data set approximately 90% of casts were retained; all 55 casts were from shallow AXBT's.

The data have been transferred on digital tape to the National Oceanographic Data Center in Washington, D.C.

DATA PRESENTATION

The cruise track, station locations and station numbers are shown in Figures 2, 3, and 4, respectively. These figures are followed by a listing of the stations, with their coordinates, and the date and time at which the station was occupied.

Temperature profiles from the AXBT casts in Legs I an II are shown in staggered fashion in Figures 5 and 6, respectively. The location of these profiles may be found by reference to the various maps of the cruise track. Transect extremes are identified as nearly as possible. The first profile on each plot is shown with its temperature unchanged; to each subsequent profile an appropriate multiple of 5C has been added.

Isotherms along each transect are shown in Figures 7 and 8. Transect extremes are identified. Based on instrument accuracy and the vertical temperature

gradient, it is estimated that depths of isotherms in the main thermocline are uncertain to ±20m.

The data presentation concludes with plots of mean temperature profiles, with + and - the standard deviations, from each of the flight legs.

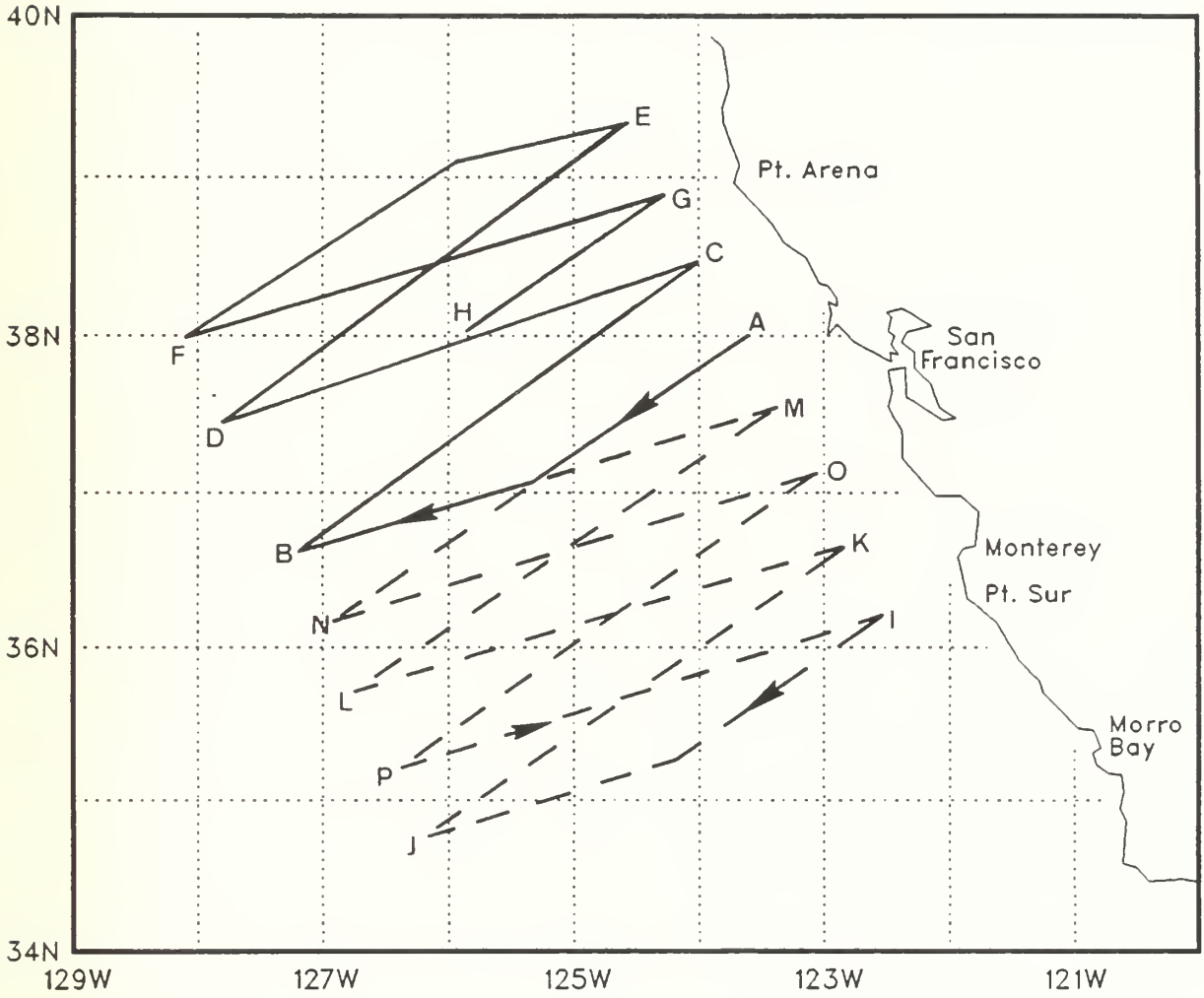


Figure 2: The cruise track for OPTOMA8. The track for Leg I on 10 December, 1983 is shown by the solid line; the track for Leg II on 15 December, 1983 is shown by the broken line.

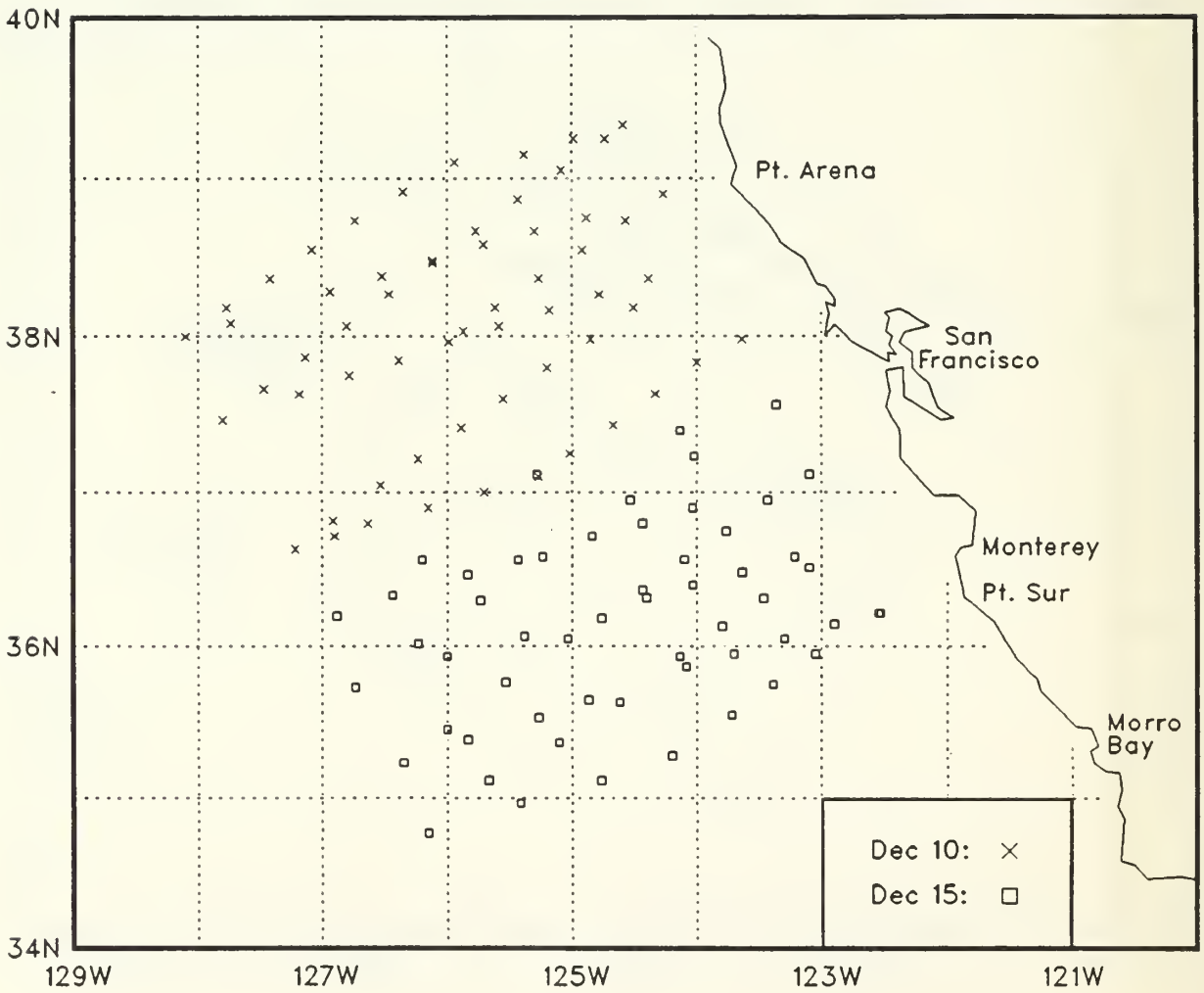


Figure 3: AXBT station locations for OPTOMA8.

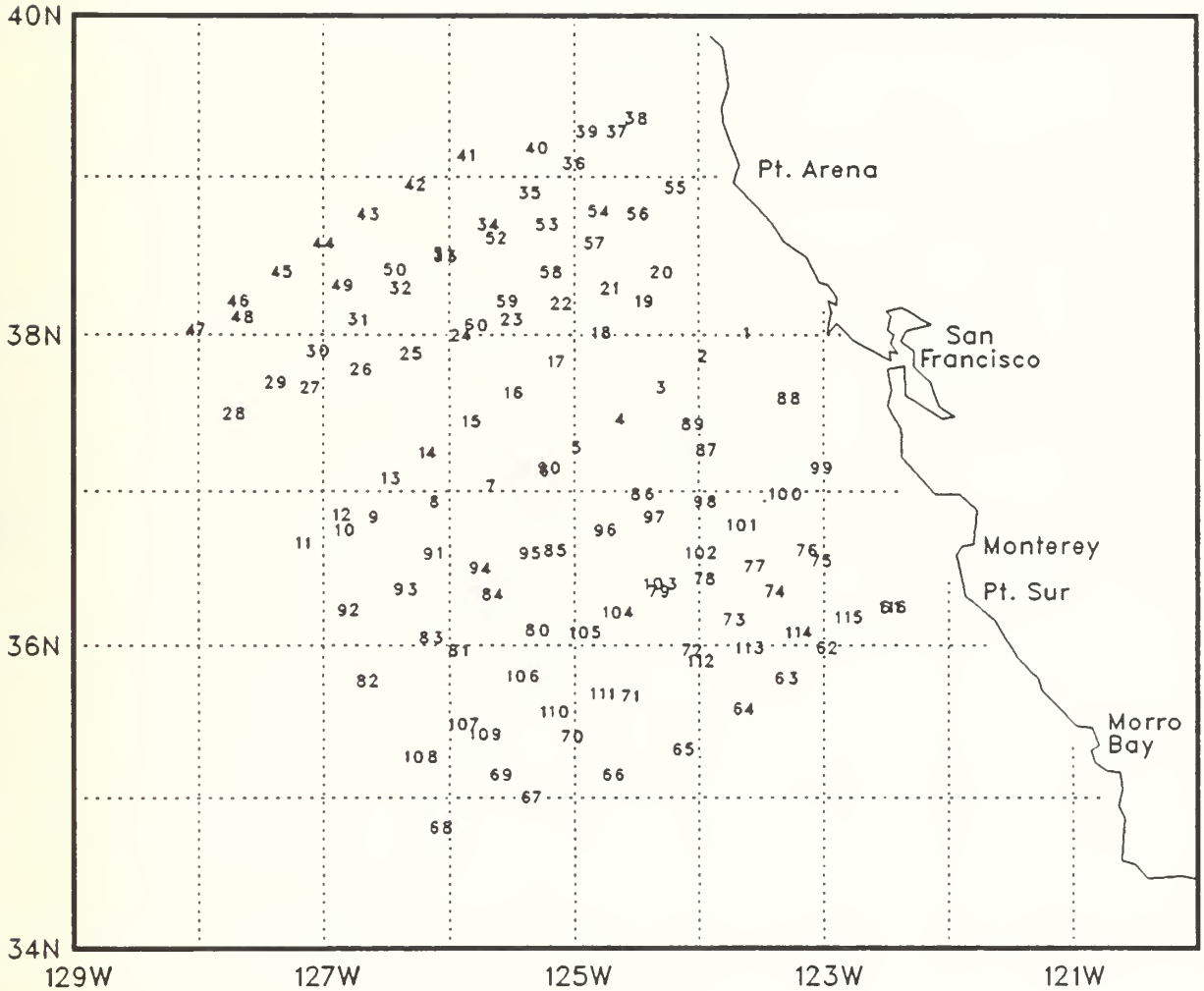


Figure 4: Station numbers for OPTOMA8.

Table 1: Leg I Station Listing

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)
1	AXBT	83344	1928	37.59	123.38	13.4
2	AXBT	83344	1934	37.50	124.00	13.4
3	AXBT	83344	1939	37.38	124.20	13.7
4	AXBT	83344	1944	37.26	124.40	13.8
5	AXBT	83344	1949	37.15	125.01	14.0
6	AXBT	83344	1953	37.06	125.16	13.8
7	AXBT	83344	1959	37.00	125.42	14.4
8	AXBT	83344	2004	36.54	126.09	14.1
9	AXBT	83344	2009	36.48	126.38	14.2
10	AXBT	83344	2014	36.43	126.54	14.4
11	AXBT	83344	2018	36.38	127.13	14.4
12	AXBT	83344	2025	36.49	126.55	14.2
13	AXBT	83344	2031	37.03	126.32	14.4
14	AXBT	83344	2035	37.13	126.14	14.6
15	AXBT	83344	2040	37.25	125.53	14.6
16	AXBT	83344	2045	37.36	125.33	14.4
17	AXBT	83344	2050	37.48	125.12	14.1
18	AXBT	83344	2055	37.59	124.51	13.0
19	AXBT	83344	2100	38.11	124.30	13.1
20	AXBT	83344	2115	38.22	124.23	13.2
21	AXBT	83344	2120	38.16	124.47	13.2
22	AXBT	83344	2125	38.10	125.11	14.0
23	AXBT	83344	2130	38.04	125.35	14.3
24	AXBT	83344	2135	37.58	125.59	14.5
25	AXBT	83344	2140	37.51	126.23	14.4
26	AXBT	83344	2145	37.45	126.47	14.9
27	AXBT	83344	2150	37.38	127.11	15.0
28	AXBT	83344	2158	37.28	127.48	14.8
29	AXBT	83344	2205	37.40	127.28	14.9
30	AXBT	83344	2210	37.52	127.08	14.4
31	AXBT	83344	2215	38.04	126.48	14.3
32	AXBT	83344	2220	38.16	126.28	14.4
33	AXBT	83344	2225	38.28	126.07	14.6
34	AXBT	83344	2230	38.40	125.46	14.7
35	AXBT	83344	2235	38.52	125.26	14.7
36	AXBT	83344	2240	39.03	125.05	14.2
37	AXBT	83344	2245	39.15	124.44	14.5
38	AXBT	83344	2247	39.20	124.35	14.2
39	AXBT	83344	2254	39.15	124.59	14.4
40	AXBT	83344	2259	39.09	125.23	14.5
41	AXBT	83344	2306	39.06	125.56	14.5
42	AXBT	83344	2312	38.55	126.21	14.8
43	AXBT	83344	2318	38.44	126.44	14.2
44	AXBT	83344	2323	38.33	127.05	14.1
45	AXBT	83344	2328	38.22	127.25	14.3

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)
46	AXBT	83344	2332	38.11	127.46	14.2
47	AXBT	83344	2337	38.00	128.06	14.3
48	AXBT	83344	2344	38.05	127.44	14.6
49	AXBT	83344	2354	38.17	126.56	14.2
50	AXBT	83344	2359	38.23	126.31	14.6
51	AXBT	83345	4	38.29	126.07	14.6
52	AXBT	83345	10	38.35	125.42	14.6
53	AXBT	83345	15	38.40	125.18	14.5
54	AXBT	83345	19	38.45	124.53	13.7
55	AXBT	83345	27	38.54	124.16	13.3
56	AXBT	83345	33	38.44	124.34	14.1
57	AXBT	83345	38	38.33	124.55	13.9
58	AXBT	83345	44	38.22	125.16	13.8
59	AXBT	83345	48	38.11	125.37	14.5
60	AXBT	83345	52	38.02	125.52	14.4

Table 2: Leg II Station Listing

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)
61	AXBT	83349	1838	36.13	122.32	14.0
62	AXBT	83349	1845	35.57	123.03	14.5
63	AXBT	83349	1850	35.45	123.23	14.5
64	AXBT	83349	1854	35.33	123.43	14.8
65	AXBT	83349	1901	35.17	124.12	16.3
66	AXBT	83349	1909	35.07	124.46	14.7
67	AXBT	83349	1918	34.58	125.25	14.8
68	AXBT	83349	1927	34.46	126.09	15.9
69	AXBT	83349	1938	35.07	125.40	14.8
70	AXBT	83349	1947	35.22	125.06	14.5
71	AXBT	83349	1955	35.38	124.37	14.7
72	AXBT	83349	2003	35.56	124.08	14.5
73	AXBT	83349	2008	36.08	123.48	14.7
74	AXBT	83349	2014	36.19	123.28	14.3
75	AXBT	83349	2020	36.31	123.06	14.0
76	AXBT	83349	2027	36.35	123.13	14.0
77	AXBT	83349	2032	36.29	123.38	14.5
78	AXBT	83349	2037	36.24	124.02	14.5
79	AXBT	83349	2042	36.19	124.24	14.4
80	AXBT	83349	2046	36.04	125.23	13.9
81	AXBT	83349	2103	35.56	126.00	13.8
82	AXBT	83349	2112	35.44	126.44	14.2
83	AXBT	83349	2123	36.01	126.14	13.8
84	AXBT	83349	2131	36.18	125.44	14.4
85	AXBT	83349	2138	36.35	125.14	13.9
86	AXBT	83349	2149	36.57	124.32	13.5
87	AXBT	83349	2156	37.14	124.01	13.5
88	AXBT	83349	2206	37.34	123.22	12.8
89	AXBT	83349	2220	37.24	124.08	13.2
90	AXBT	83349	2234	37.07	125.17	14.1
91	AXBT	83349	2247	36.34	126.12	14.3
92	AXBT	83349	2257	36.12	126.53	14.4
93	AXBT	83349	2307	36.20	126.26	14.1
94	AXBT	83349	2315	36.28	125.50	14.2
95	AXBT	83349	2319	36.34	125.26	14.6
96	AXBT	83349	2327	36.43	124.50	13.6
97	AXBT	83349	2332	36.48	124.26	13.5
98	AXBT	83349	2337	36.54	124.02	13.6
99	AXBT	83349	2349	37.07	123.06	13.6
100	AXBT	83349	2355	36.57	123.26	13.7
101	AXBT	83349	2359	36.45	123.46	13.8
102	AXBT	83350	4	36.34	124.06	14.6
103	AXBT	83350	9	36.22	124.26	14.4
104	AXBT	83350	13	36.11	124.46	13.5
105	AXBT	83350	17	36.03	125.02	14.1

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)
106	AXBT	83350	24	35.46	125.32	14.4
107	AXBT	83350	30	35.27	126.00	14.7
108	AXBT	83350	36	35.14	126.21	15.5
109	AXBT	83350	46	35.23	125.50	15.0
110	AXBT	83350	54	35.32	125.16	14.4
111	AXBT	83350	59	35.39	124.52	14.6
112	AXBT	83350	109	35.52	124.05	14.9
113	AXBT	83350	113	35.57	123.42	14.6
114	AXBT	83350	118	36.03	123.18	14.6
115	AXBT	83350	123	36.09	122.54	14.4
116	AXBT	83350	127	36.13	122.33	13.8

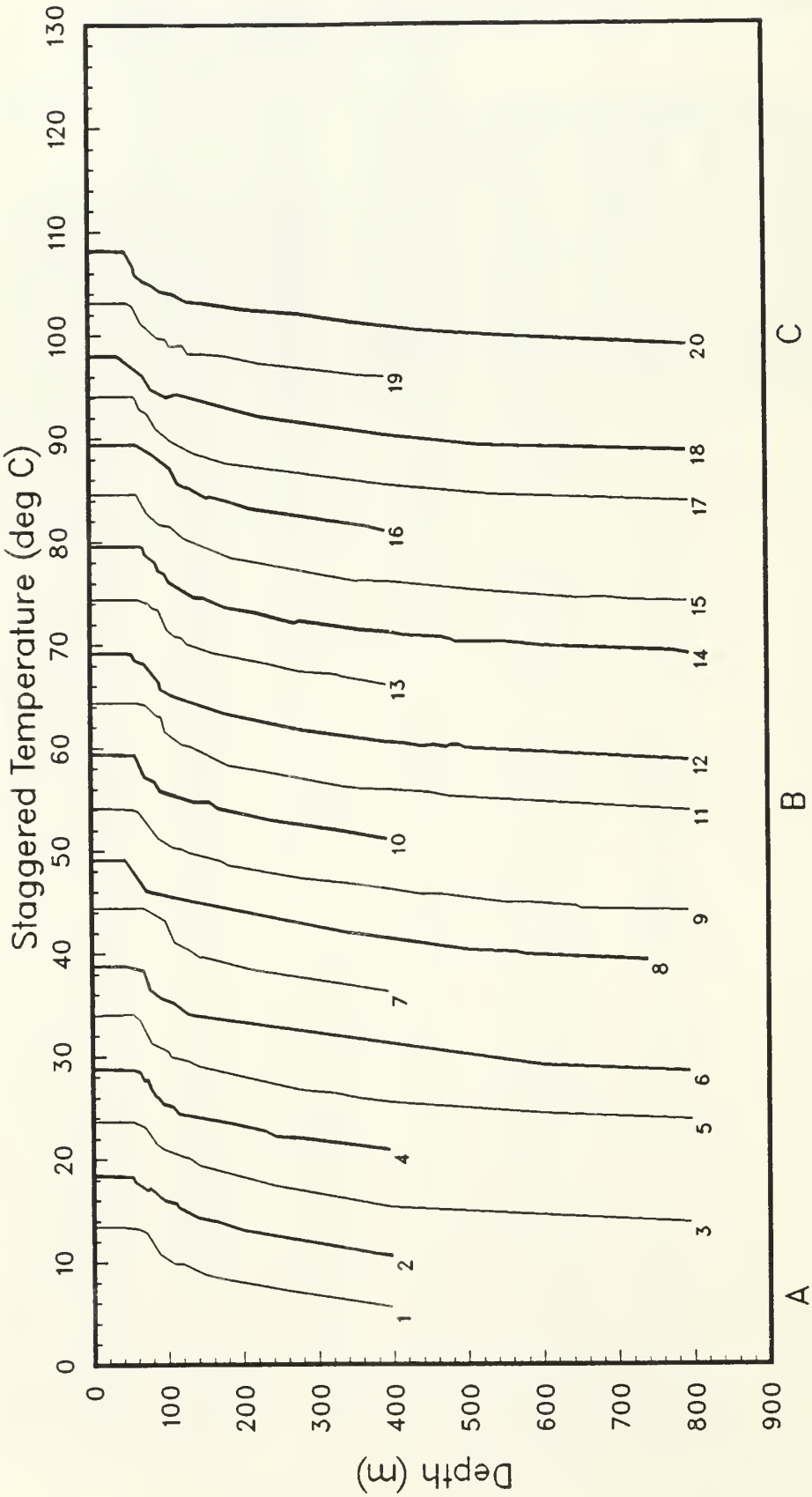


Figure 5(a): Temperature profiles staggered by multiples of 5C. (OPTOMA8, Leg I).

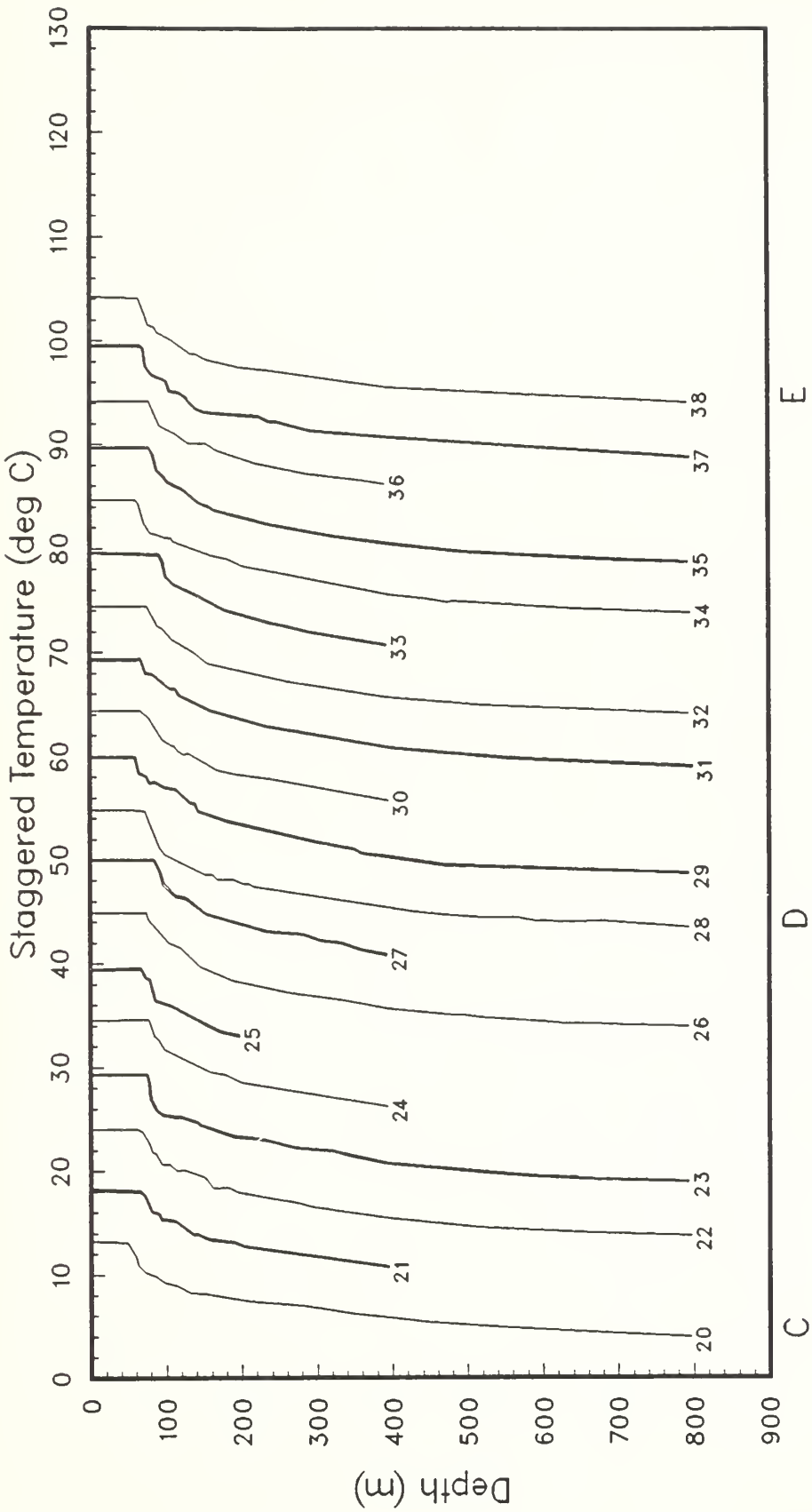

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Depth (m)
0
100
200
300
400
500
600
700
800
900
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
C
D
E

Figure 5(b).

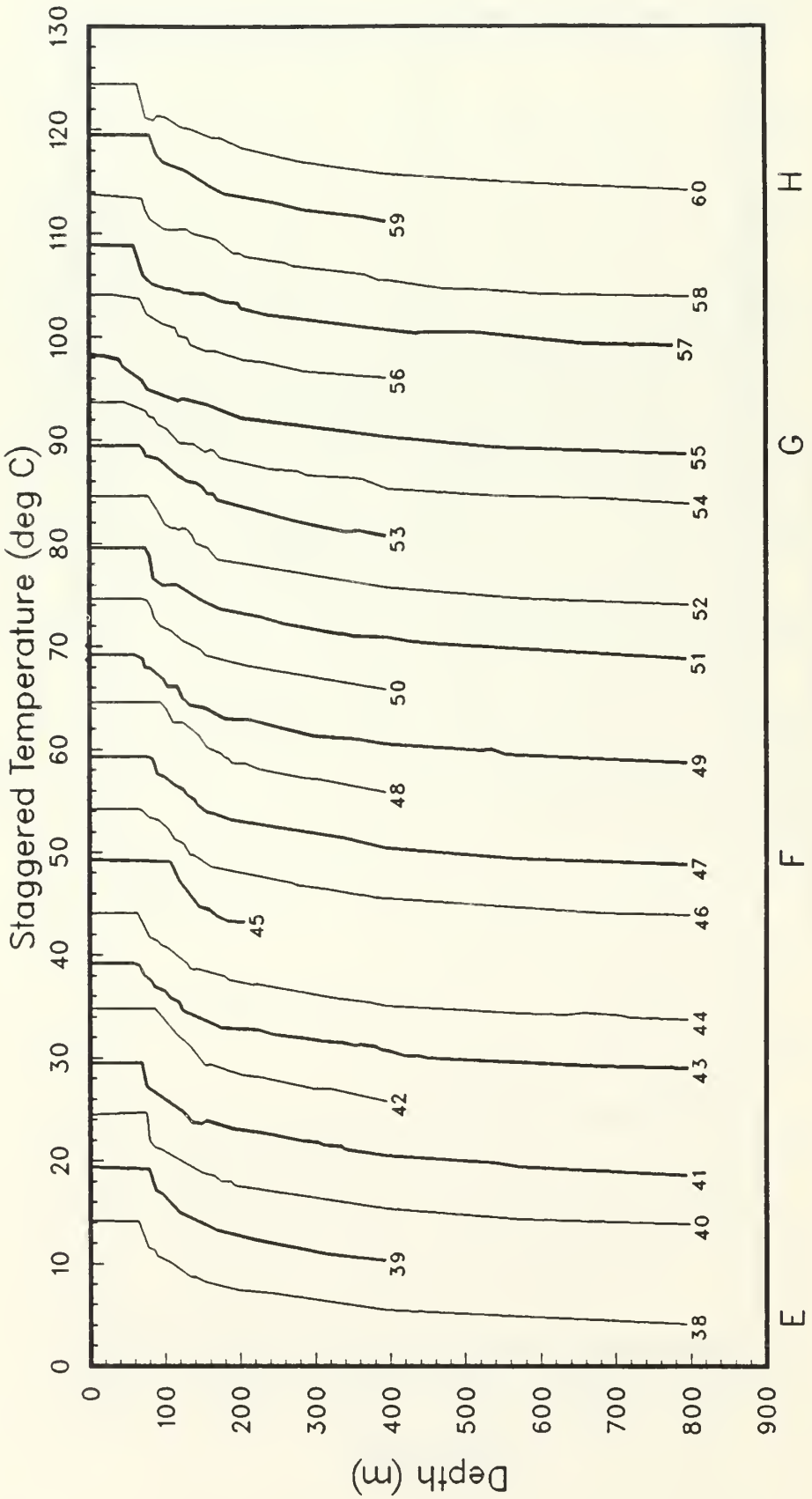

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Depth (m)
0
100
200
300
400
500
600
700
800
900
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
E
F
G
H

Figure 5(c).

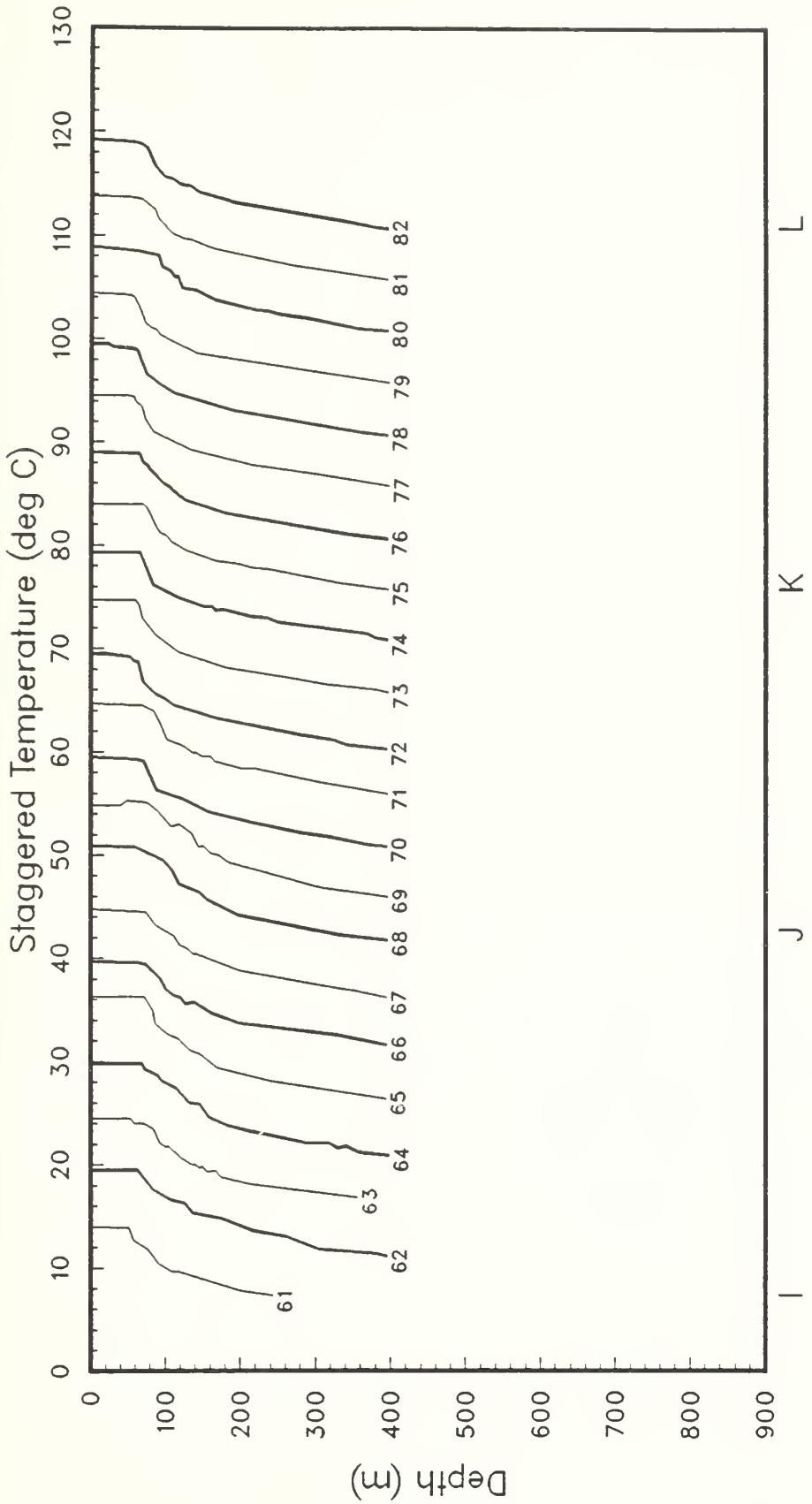


Figure 6(a): Temperature profiles staggered by multiples of 5C. (OPTOMA8, Leg II).

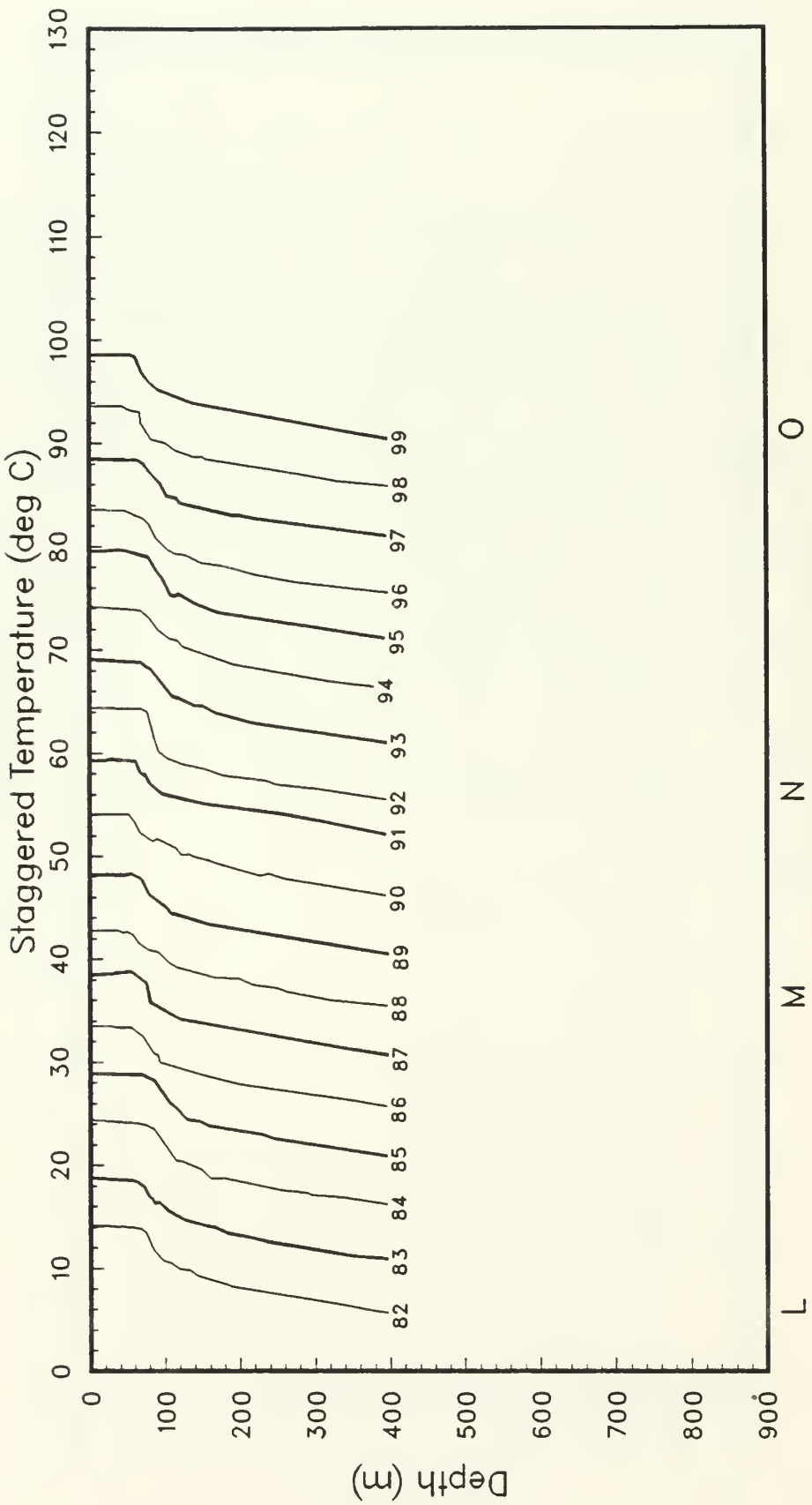

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Depth (m)
0
100
200
300
400
500
600
700
800
900
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
L
M
N
O

Figure 6(b).

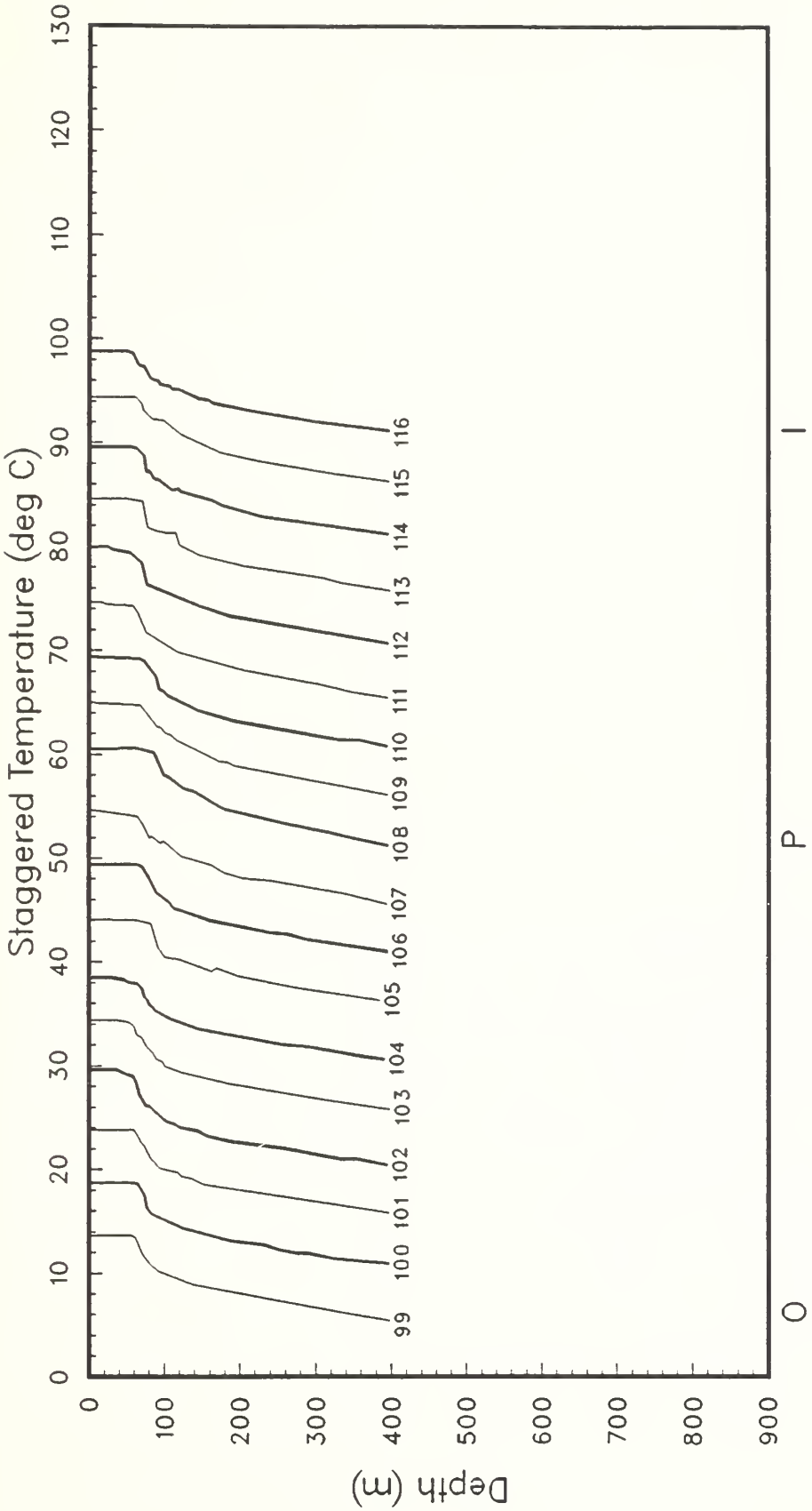
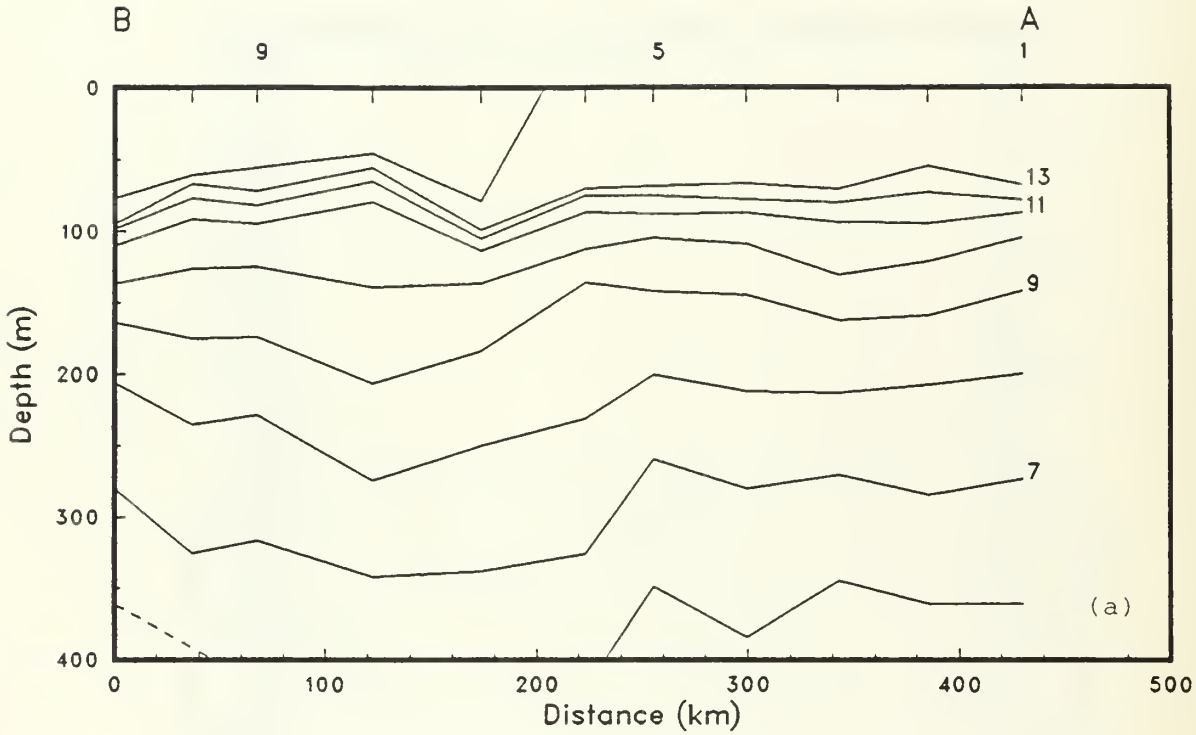

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Depth (m)
0
100
200
300
400
500
600
700
800
900
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
O
P
I

Figure 6(c).



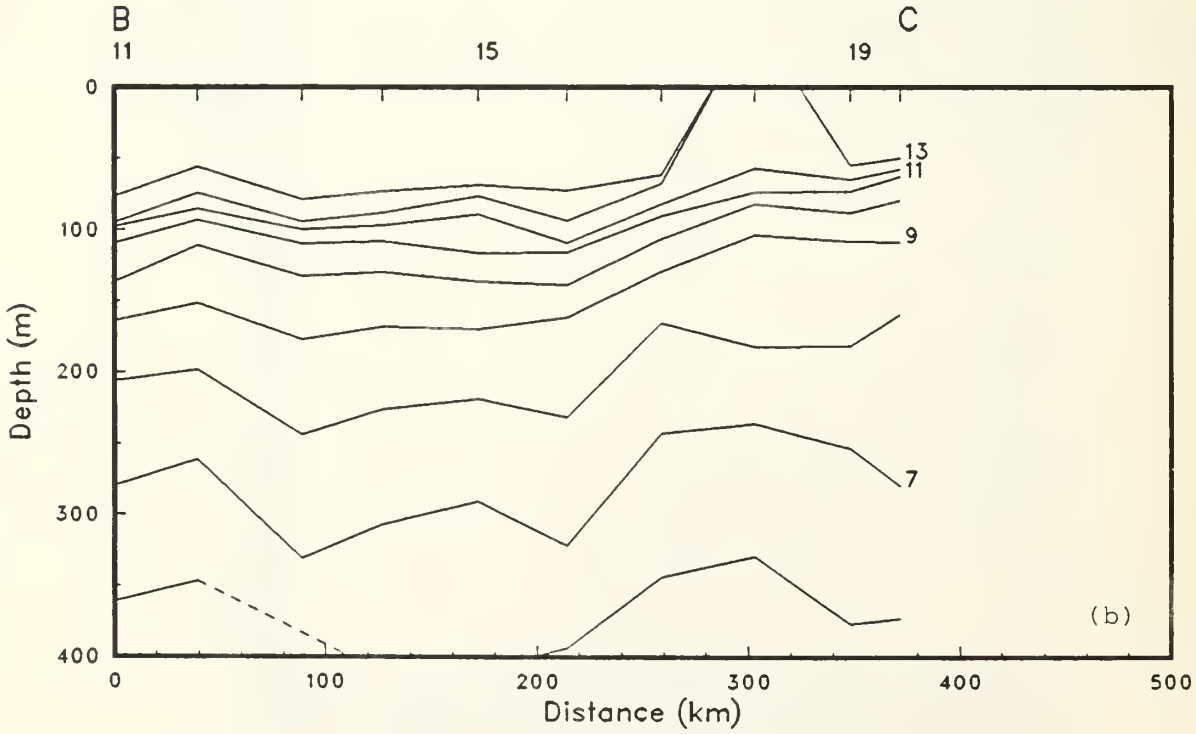


Figure 7(a), (b): Along-track isotherms. Tick marks along the upper horizontal axis show station positions. Some station numbers are given. Dashed lines are used if the cast was too shallow. (OPTOMA8, Leg I).

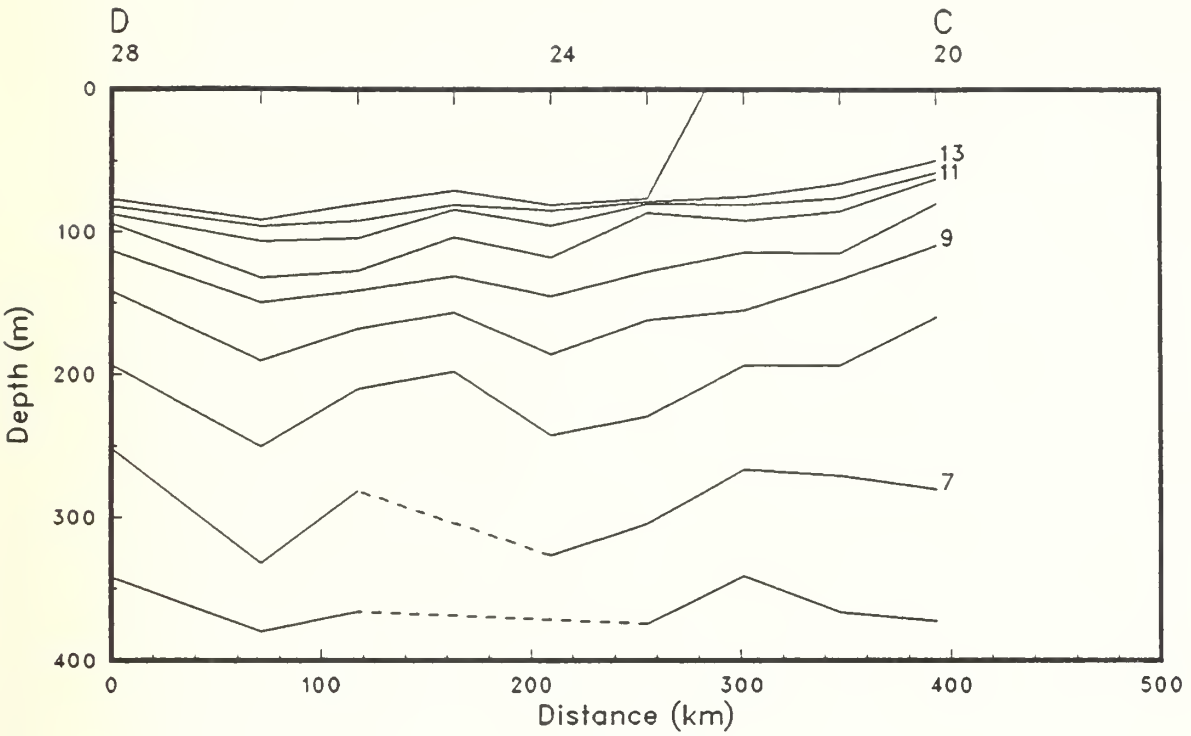


Figure 7(c).

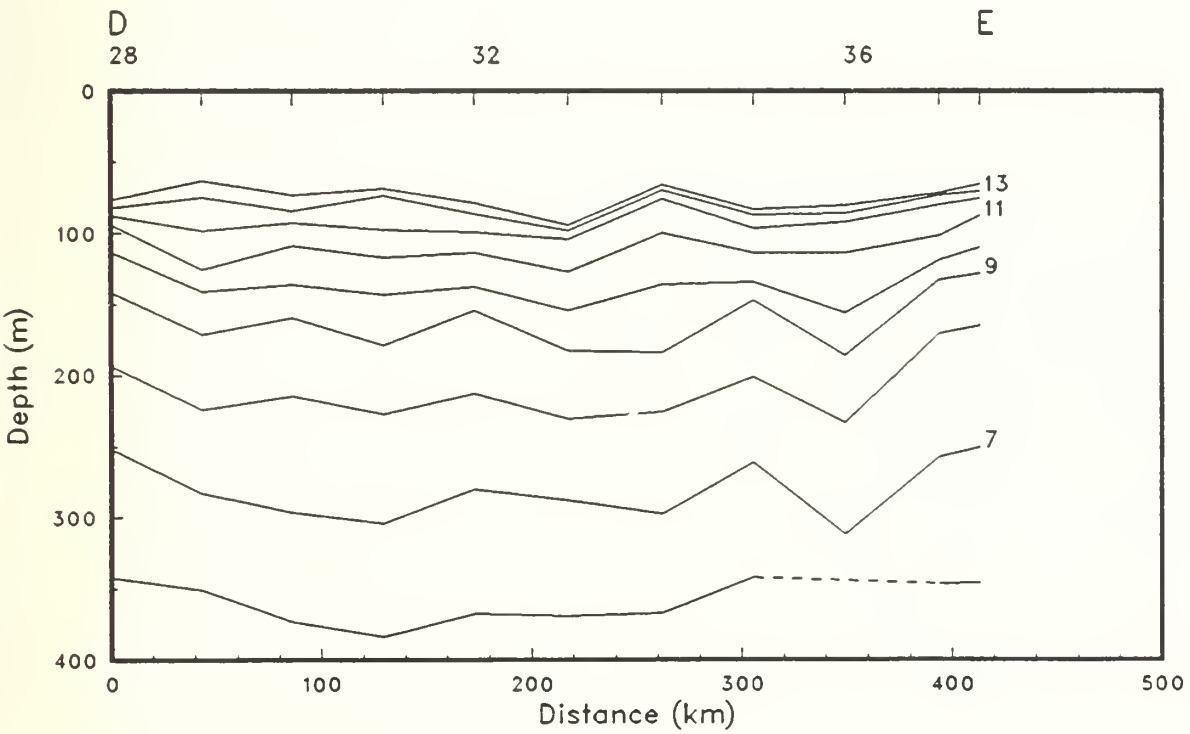


Figure 7(d).

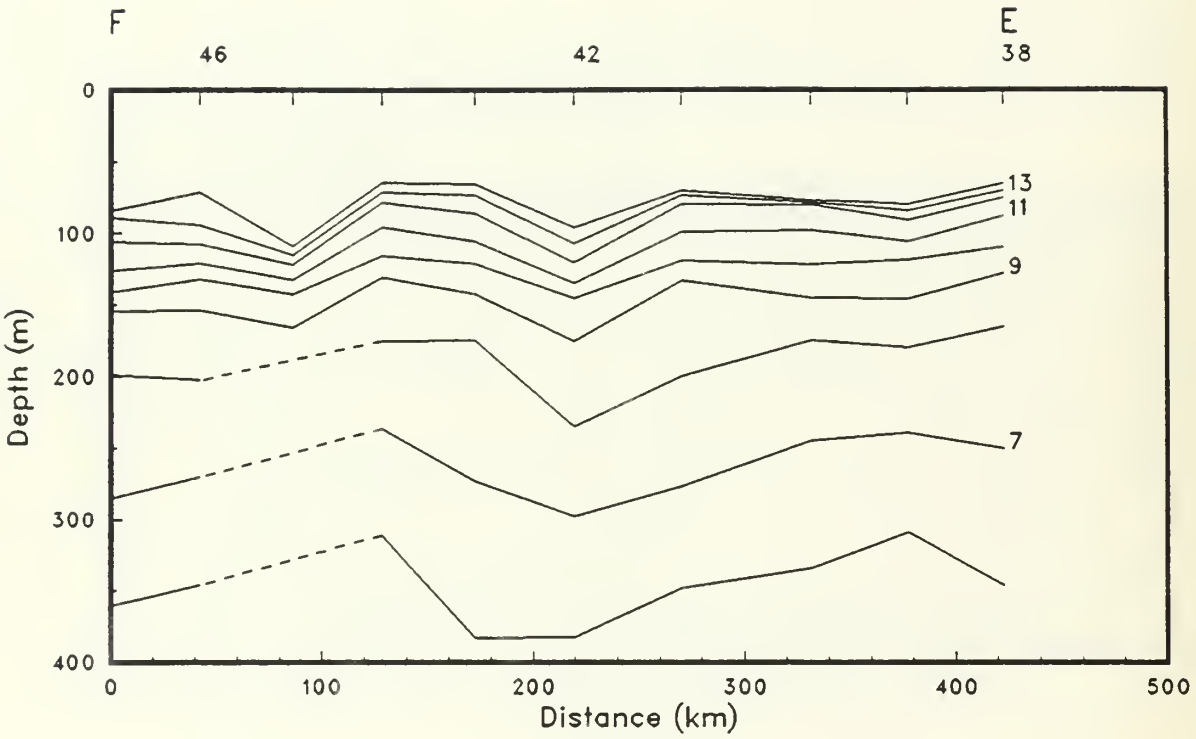


Figure 7(e).

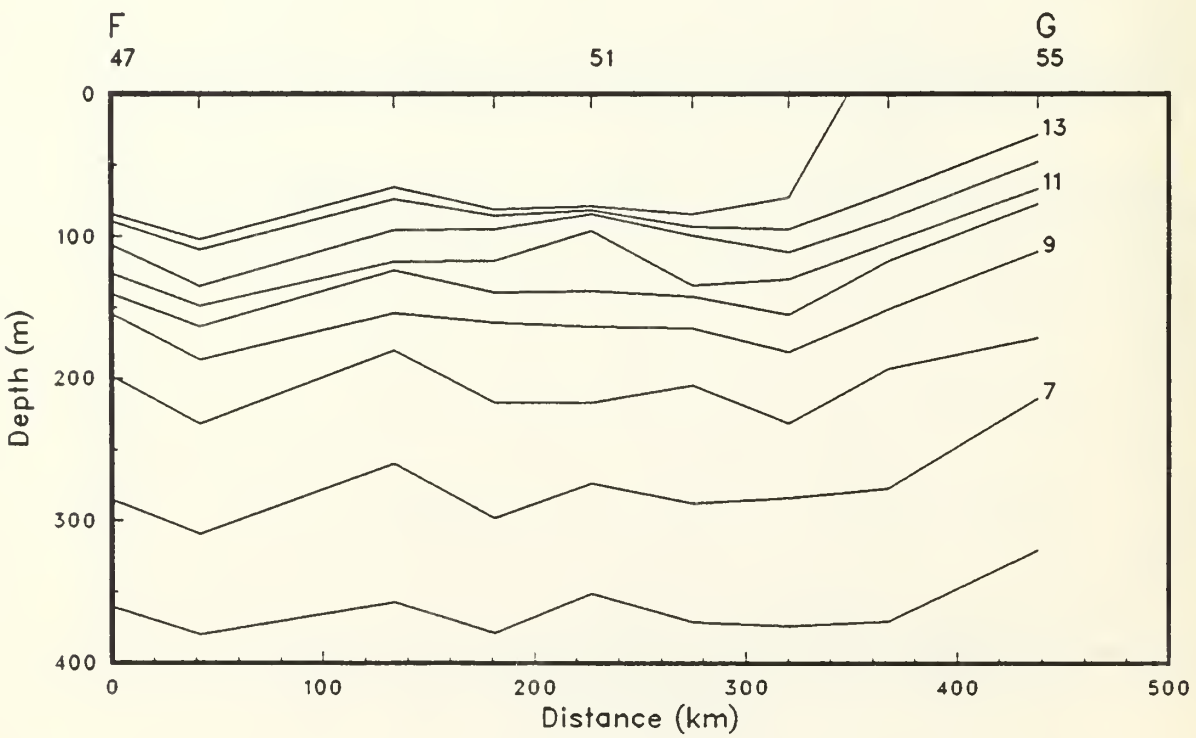


Figure 7(f).

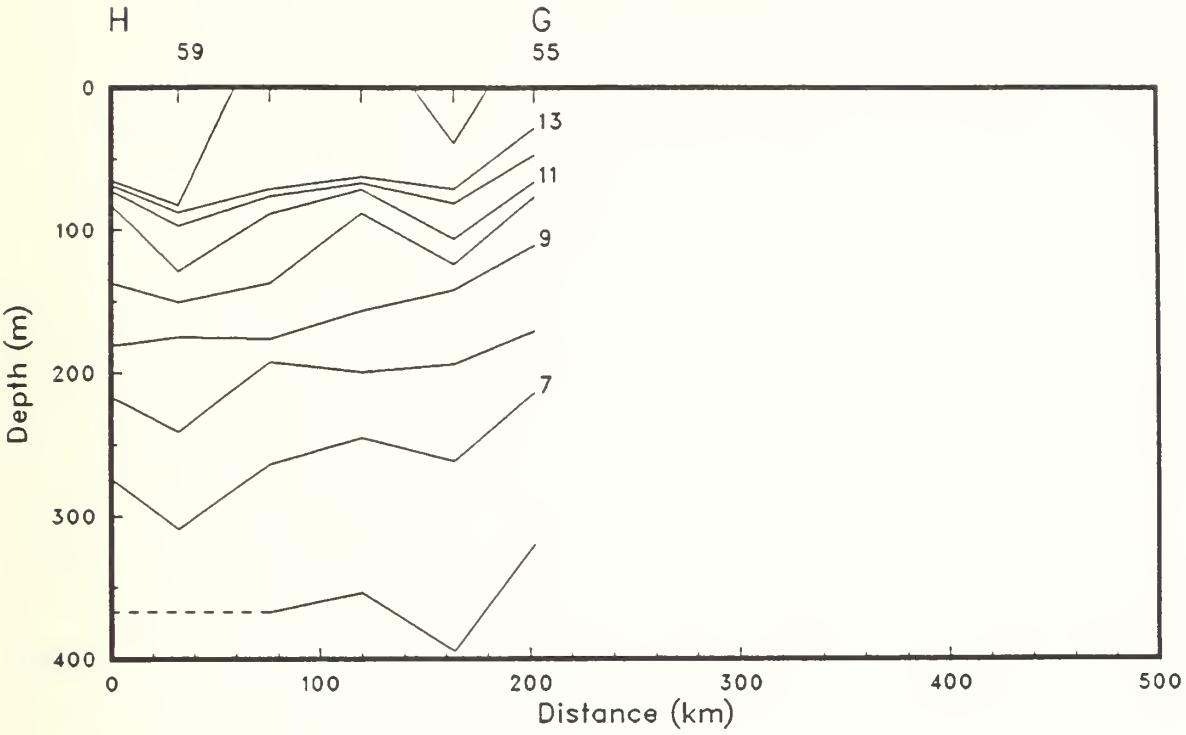
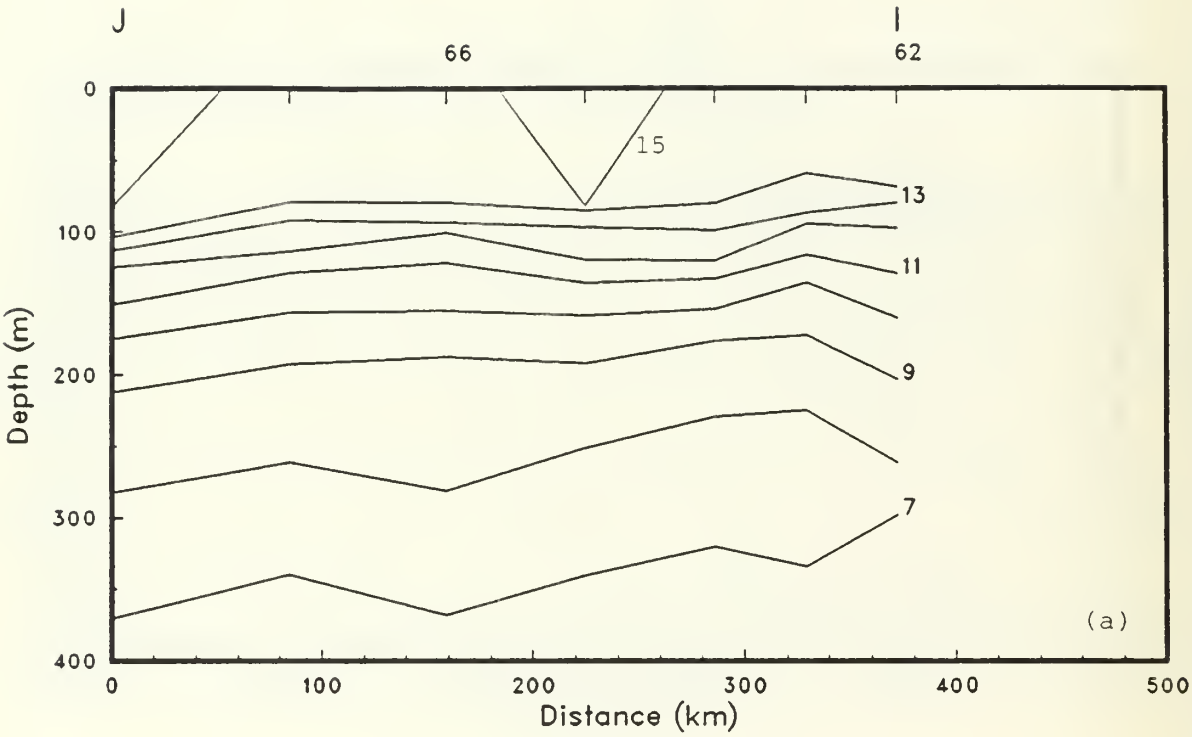

H
G
59
55
0
100
200
300
400
Depth (m)
13
11
9
7
0
100
200
300
400
500
Distance (km)

Figure 7(g).



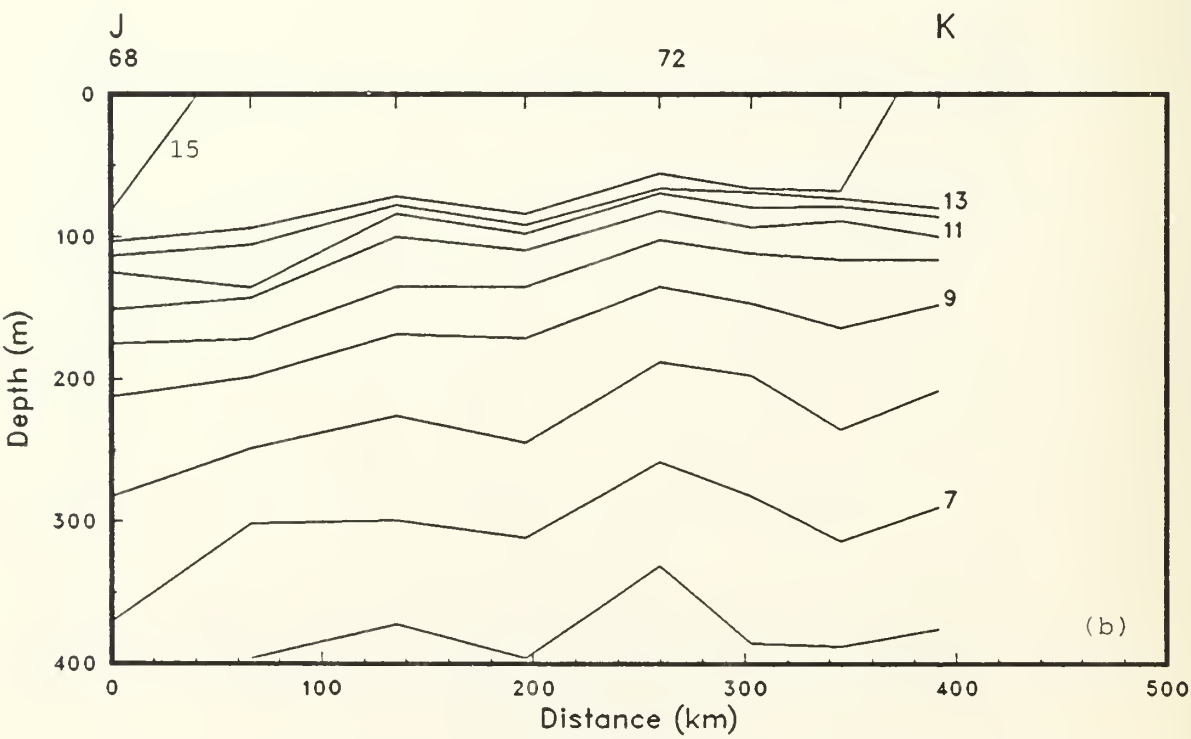


Figure 8(a), (b): Along-track isotherms. Tick marks along the upper horizontal axis show station positions. Some station numbers are given. Dashed lines are used if the cast was too shallow. (OPTOMA8, Leg II).

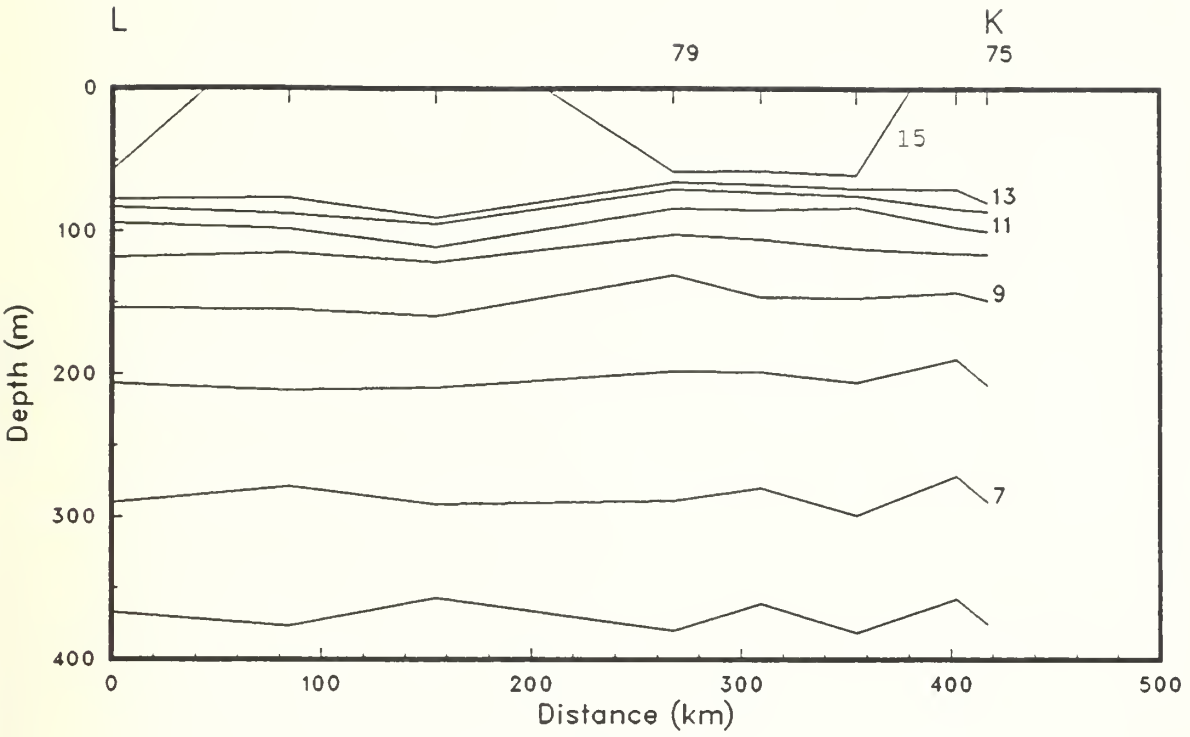


Figure 8(c).

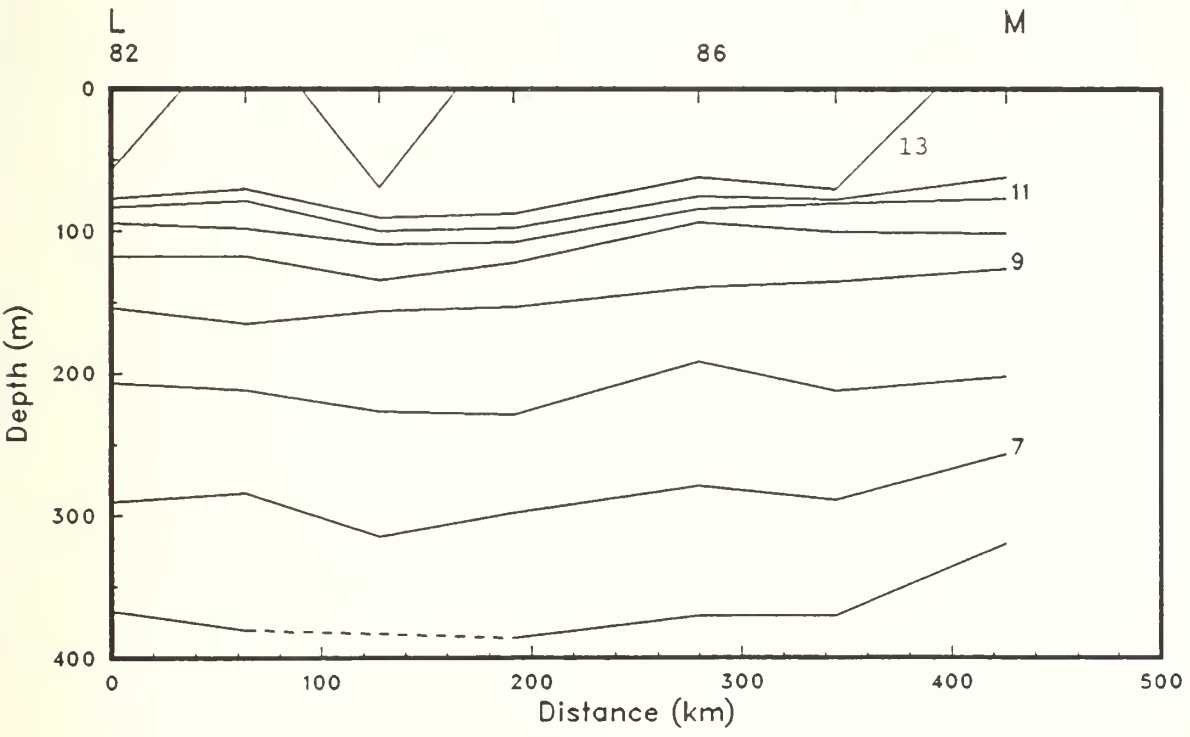


Figure 8(d).

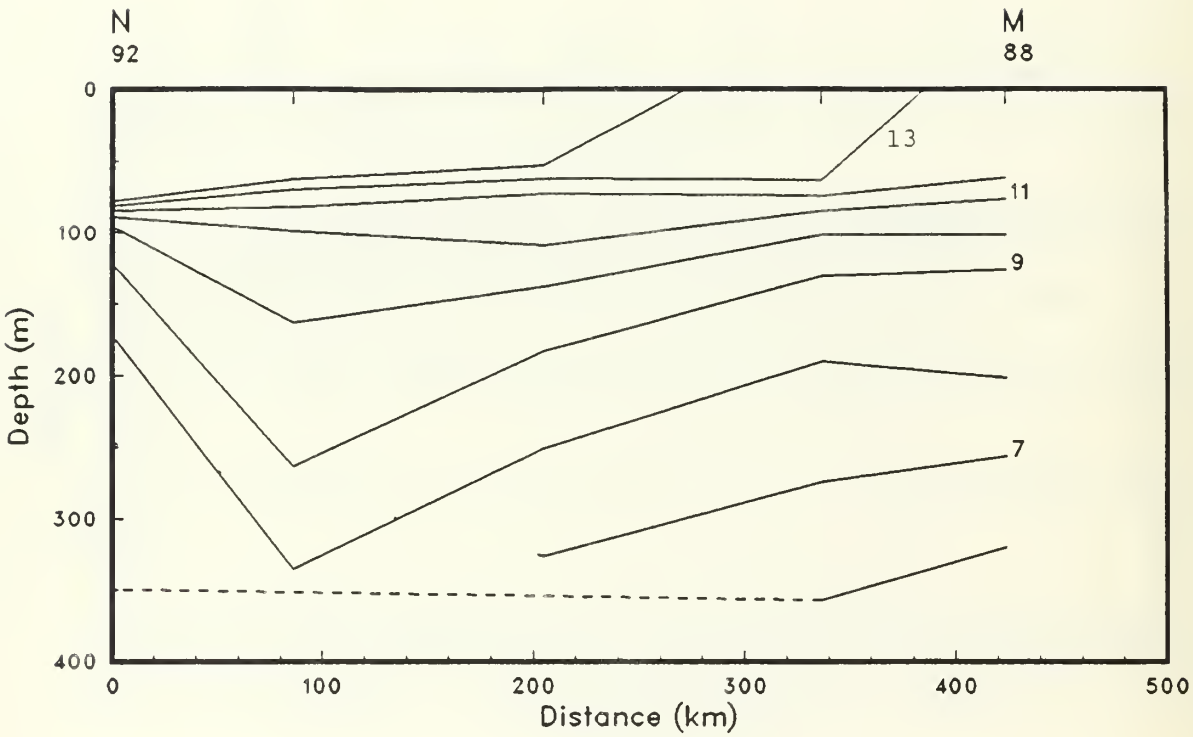


Figure 8(e).

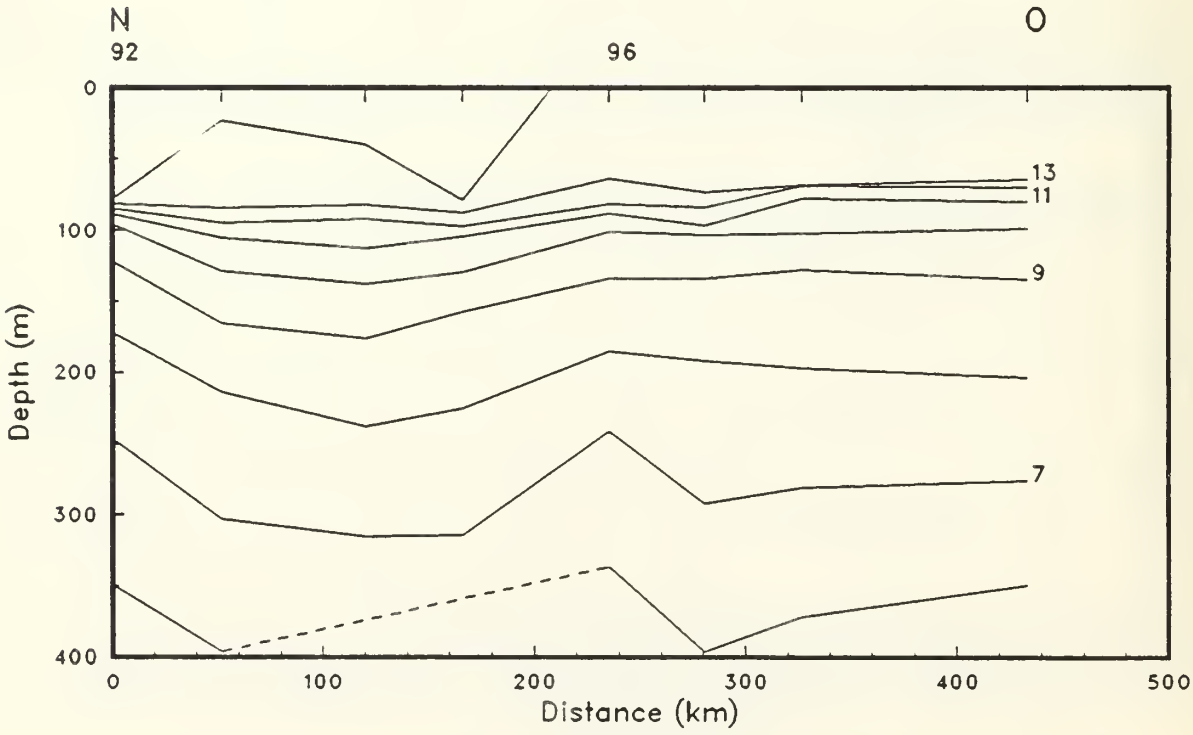


Figure 8(f).

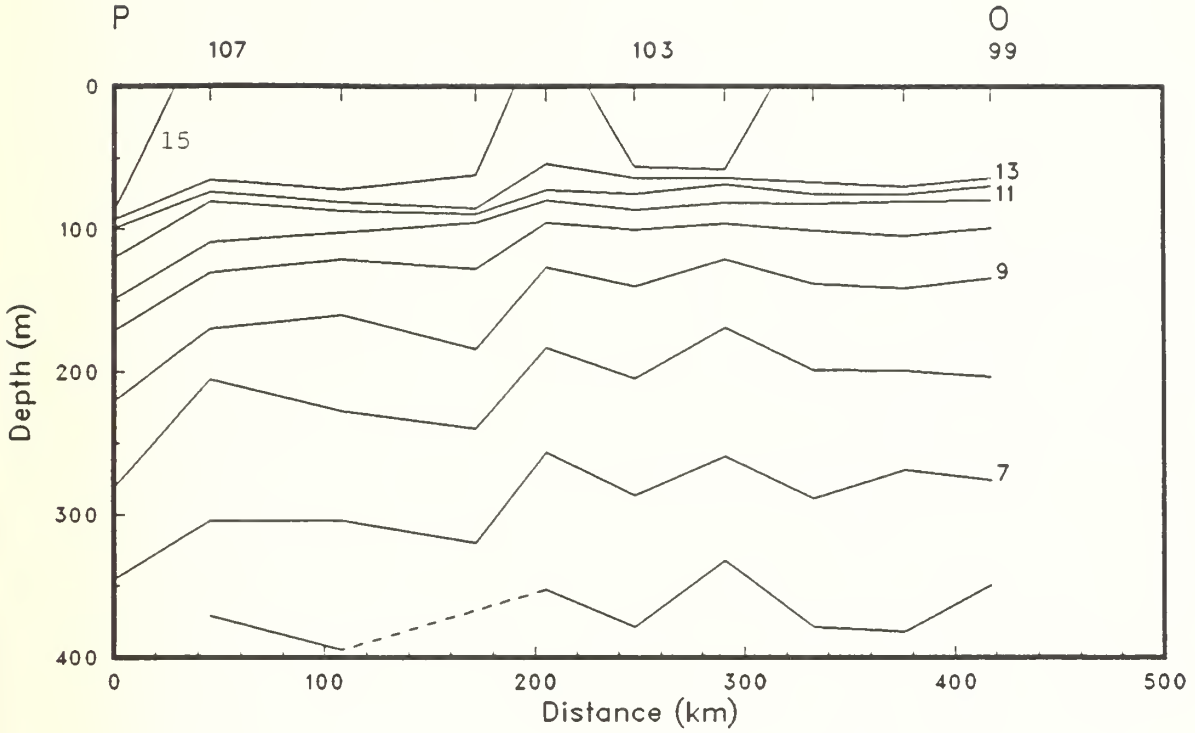


Figure 8(g).

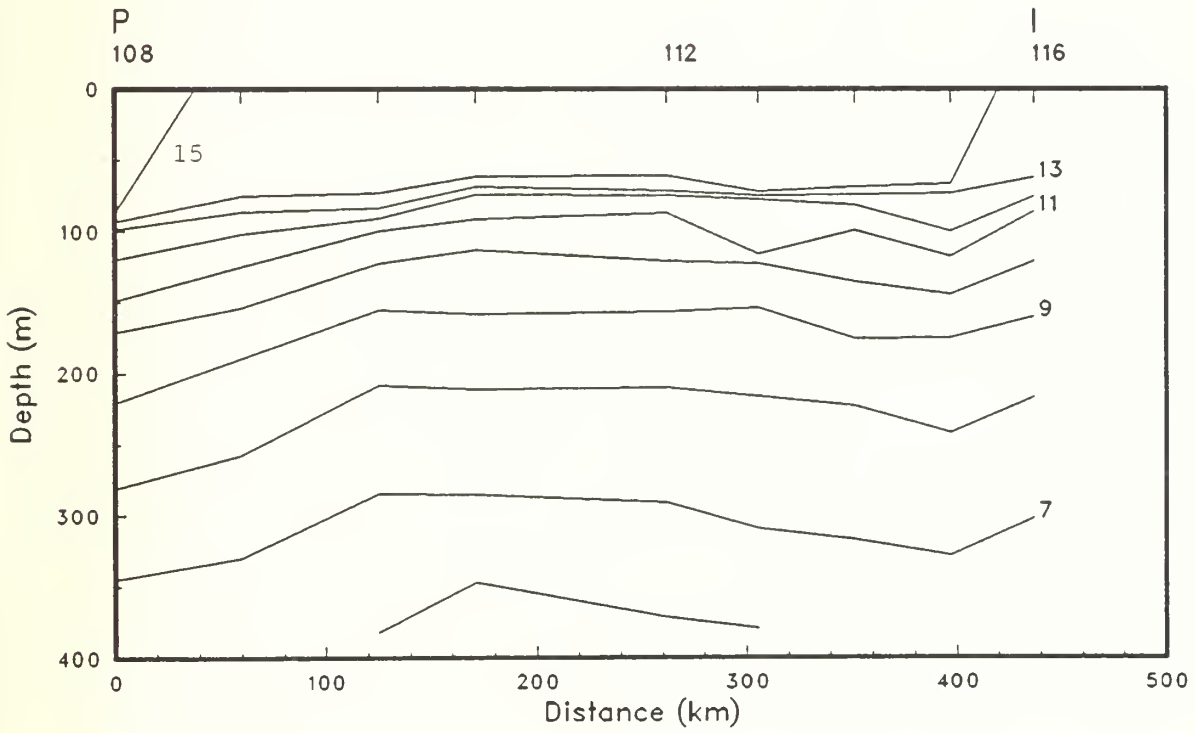


Figure 8(h).

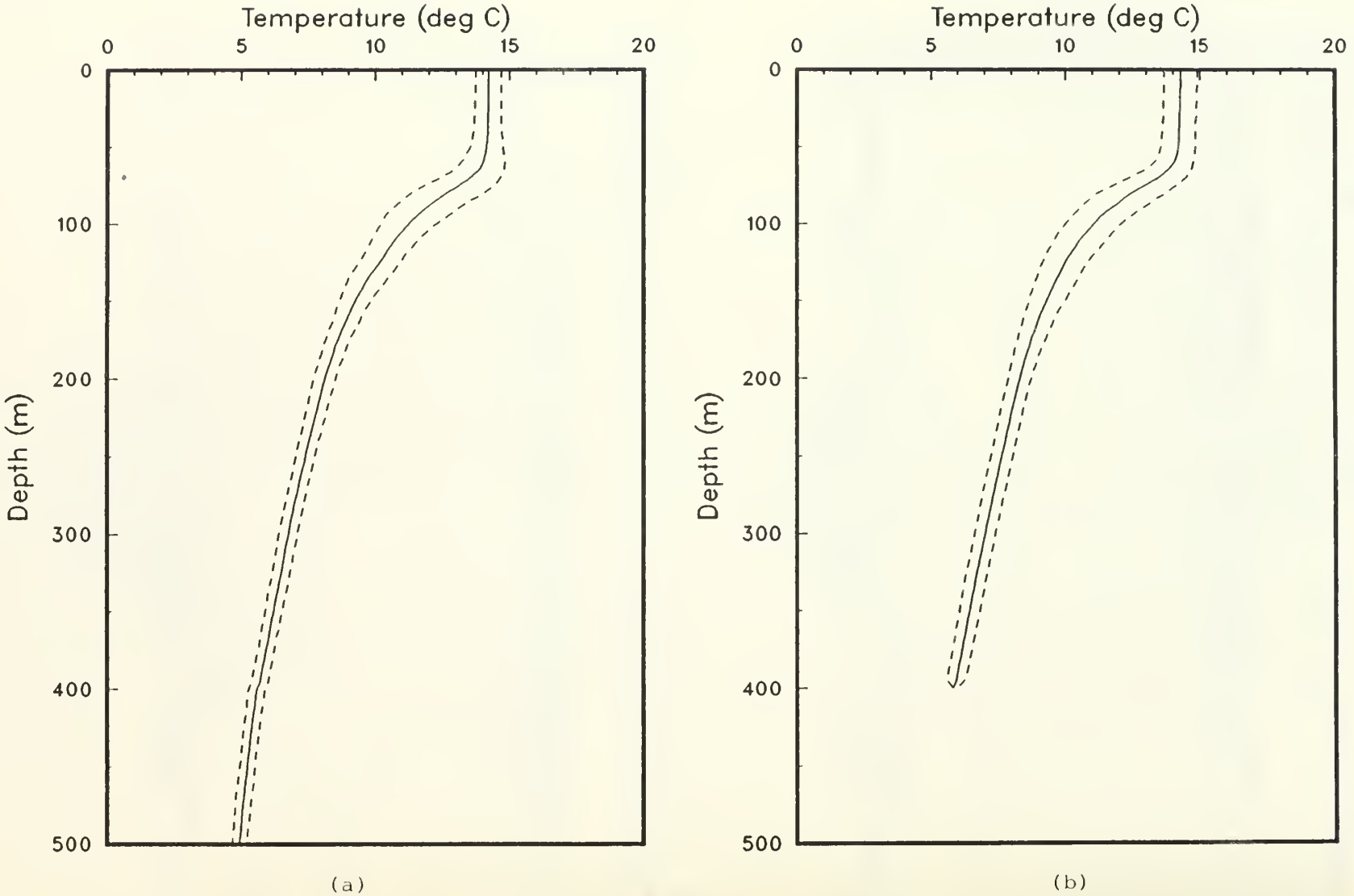


Figure 9: Mean temperature profiles, with + and - the standard deviations, from OPTOMA8: (a) Leg I and (b) Leg II.

ACKNOWLEDGEMENTS

This research was sponsored by the ONR Physical Oceanography Program. The success of the fieldwork was strongly dependent on the competent, willing support of the P3 Reserve Patrol Wing. The digitization carried out by the Fleet Support Branch of NAVOCEANO in Bay St. Louis is gratefully acknowledged.

INITIAL DISTRIBUTION LIST

1.	Defense Technical Information Center Cameron Station Alexandria, VA 22314	2
2.	Dudley Knox Library Code 0142 Naval Postgraduate School Monterey, CA 93943	2
3.	Prof. C.N.K. Mooers, Code 68Mr Naval Postgraduate School Monterey, CA 93943	52
4.	Prof. Allan R. Robinson Division of Applied Sciences Pierce Hall, Room 100D Harvard University Cambridge, MA 02138	8
5.	Dr. Thomas W. Spence Office of Naval Research 800 N. Quincy St. Arlington, VA 22217	1
6.	Naval Postgraduate School Department of Oceanography, Code 68	
	ATTN: Dr. Michele M. Rienecker, Code 68Rr	1
	ATTN: Dr. Edward A. Kelley, Code 68Kp	1
	ATTN: Dr. Laurence C. Breaker, Code 68By	1
	ATTN: Dr. Mary Batteen, Code 68Bv	1
	ATTN: Ms. Marie C. Colton	1
	ATTN: Mr. Paul A. Wittmann	1
7.	Prof. R.L. Smith College of Oceanography Oregon State University Corvallis, OR 97331	1
8.	Dr. Denise E. Hagan Jet Propulsion Laboratory, Code 183-501 4800 Oak Grove Road Pasadena, CA 91109	1
9.	Commanding Officer Fleet Numerical Oceanography Center Monterey, CA 93943	
	ATTN: CDR John F. Pfeiffer, USN	1
	ATTN: LCDR Michael R. Frost, RN	1
	ATTN: Mr. R. Michael Clancy	1
	ATTN: Mr. Ken Pollack	1
	ATTN: Ms. Evelyn Hesse	1

10. SANDIA National Laboratories
    ATTN: Dr. Mel Marietta 1
    ATTN: Dr. Eugene S. Hertel 1
    Div. 6334
    Albuquerque, NM 87185

11. LCDR Craig S. Nelson, NOAA Corps 1
    Marine Products Branch, W/NMC21
    National Meteorological Center
    National Weather Service, NOAA
    Washington, DC 20233

12. Commanding Officer
    ATTN: Dr. Steve A. Piacsek 1
    ATTN: Dr. Dana A. Thompson 1
    ATTN: Dr. Harley C. Hurlburt 1
    ATTN: Dr. Alexander Warn-Varnas 1
    Naval Ocean Research and Development Activity
    NSTL Station, Bay St. Louis, MS 39525

13. Scripps Institution of Oceanography
    ATTN: Ms. C. Paden 1
    ATTN: Prof. R.E. Davis 1
    University of California, San Diego
    La Jolla, CA 92093

14. Prof. George L. Mellor 1
    Geophysical Fluid Dynamics Program
    Princeton University
    P.O. Box 308
    Princeton, NJ 08540

15. Dr. Robert N. Miller 1
    Department of Mathematics
    Tulane University
    6823 St. Charles
    New Orleans, LA 70118

16. LTJG Diane C. Durban, USN 1
    NAVOCEANCOMFAC Keflavik Iceland
    FPO NY 09571